### ANNAMALAI UNIVERSITY

**Division of Microbiology**

**Faculty of Science**

**M.Sc., Microbiology Integrated (5 YEARS)**

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Objectives

The course aims to study about the introduction, historical development and application of microbiology.

Unit - I


Unit - II

Microscopy: Principles and applications of simple, compound, bright field, dark field, phase contrast, fluorescent and Electron microscope [SEM & TEM].

Unit - III

General characteristics and nature of Archaebacteria, Eubacteria, Cyanobacteria, Mycoplasmas, Rickettsia, Chlamydia, Spirochaetes, Actinomycetes and Algae.

Unit - IV

Principles of staining: Nature of dyes, types of staining – simple, differential, negative and spore staining. Sterilization methods – Physical (moist heat, dry heat, filtration, pasteurization, tyndalization, radiations) and chemical methods (alcohols, aldehydes, phenols, halogens and hypochlorite).

Unit - V

Media types - simple, defined, enriched and transport media with specific examples for each type. Methods of maintenance and preservation of microbes.

Reference Books:

IMBT 24 - General Microbiology

Objectives

The aim of the course to learn about the cell structure, differences, media characteristics and chemotherapy.

Unit - I


Unit - II

Microbial cell : Ultrastructure of bacteria, subcellular structures and cell envelope - slime, capsule, cell wall, pili, flagella, cell inclusions, biosynthesis of bacterial cell wall, cell membrane - Bio membrane, liposomes - membrane transport - diffusion, active and passive transport and osmoregulation.

Unit - III

Nutritional types requirements of bacteria. Isolation of different types of Bacteria - Fungi - Actinomycetes - Cyanobacteria - Protozoa.

Unit - IV

Normal microbial flora of human body. Infections and its types. Pathogenesis and transmission of - Salmonella, Shigella, Chickenpox, Influenza (Flu), Aspergillus fumigatus, Candida albicans, Amoebae and Malaria.

Unit - V

Chemotherapy - general characteristics of antimicrobial drugs - Penicillin, Chloramphenicol, Nystatin, cycloheximide and Acycloguanosine (nucleoside).

Reference Books

1. Different methods of sterilization.

2. Preparation of Media:
   i. Nutrient broth
   ii. Nutrient agar
   iii. plates
   iv. slants
   v. soft agar
   vi. Blood agar
   vii. Selective Media.

3. Determination of growth - growth curve

4. Pure culture technique:
   i. Streak plate
   ii. spread plate
   iii. pour plate methods.


6. Enumeration of bacterial / yeast cells-viable count (Plate count), Total count (Haemocytometer count).

7. Motility determination
   i. Hanging drop method.

8. Staining methods:
   i. Simple
   ii. Gram staining
   iii. Negative staining
   iv. Spore staining
   v. Metachromatic granular staining
   vi. Lacto phenol cotton blue staining
   vii. Fungal slide culture.
IMBT 33 - Microbial Taxonomy

Objectives

The emphasis of the course will be on principles of classification, rules and its applications.

Unit - I

An Introduction to Microbial Classification and Taxonomy, Taxonomic Ranks. Techniques used for determination of Microbial Taxonomy & Phylogeny, Systems of Prokaryotic and Eukaryotic Phylogeny

Unit - II

Classification systems in Prokaryotes, Bergey’s Manual of Systematic Bacteriology. Prokaryotic groups with unusual characteristics: Cyanobacteria, Green and Purple sulphur bacteria, gliding bacteria, Rickettsia and Chlamydia, Actinomycetes, Archaea- Classification and Significance.

Unit - III

Viruses - Definitions of Virus, Viroids and Prions, Classification systems of Viruses -LHT, Baltimore. General Structure of viruses, Concepts of Lytic and Lysogenic life cycles , Basic Concepts of Virus cultivation

Unit - IV


Unit - V

Reference Books

**IMBP 34 - Practical II Microbial Taxonomy**

1. Morphology of Bacteria
   *Escherichia coli, Staphylococcus aureus, Vibrio cholera.*
2. Yeast
   *Candida albicans, Saccharomyces cerevisiae.*
3. Filamentous fungi
   *Aspergillus, Mucor, penicillium.*
4. Protozoa
   *Plasmodium sp., Paramecium.*
5. Algae
   *Chlorella, Oscillatoria, Nostoc.*
6. Viruses
   *HIV, TMV, T4 Bacteriophage.*
Objective

The microbial physiology deals with microbial cell structure and function, microbial growth, microbial pigments, carbon assimilation, spore, structure and function.

Unit - I


Unit - II


Unit - III


Unit - IV


Unit - V


References:


IMBP 44 - Practical III Microbial Physiology

1. Growth of Microorganisms on various carbon and Nitrogen sources.

2. Determinations of molar growth yield and ATP.

3. Turbidity measurement

4. Effect of environmental factors such as
   a. pH
   b. Temperature
   c. Carbon sources
   d. Nitrogen sources
   e. Pesticides
   f. Nutrient concentration

5. Growth and development of bacteria.
IMBT 51 - Medical Microbiology

Objectives
This course aims to study about the microorganisms associated with human beings and methods of diagnosis, symptoms caused by them. It also emphasis to learn about the viral disease and anti-microbial drugs and development of drug resistance.

Unit - I

Unit - II
Morphology, classification, cultural characteristics, Pathogenicity, laboratory diagnosis, Prevention, control and treatment of diseases caused by; Staphylococci, Streptococci, Pneumococci, Neisseria (Gonococci and Meningococci), Corynebacterium, Mycobacterium, Clostridium, Bacillus.

Unit - III
Important Gram negative Bacteria causing Human infection - Vibrio, Escherichia coli, Proteus, Klebsiella, Salmonella, Shigella, Brucella, Gram negative anaerobes - Spirochetes, Rickettsia, Chlamydia, Mycoplasma and Ureaplasma, zoonotic diseases and their control.

Unit - IV

Unit - V
Lifecycle, Pathogenicity, diagnosis, prevention and treatment of DNA & RNA viruses - Pox viruses, Herpes viruses, Adenoviruses, Hepatitis viruses: - Picorna, Orthomyxo, Paramyxo, Toga and other Arthropod borne viruses, Rhabdo, Rota and HIV, Oncogenic viruses. Viral vaccines and Antiviral agents.
Reference Books


IMBT 52 - Genetic Engineering

Unit I


Unit II

Cloning vectors - properties. Cloning in plasmid (PBR 322), phage λ. Brief account of cosmids, BACs, TACs, Shuffle vectors. Expression vectors.

Unit III


Unit IV

Screening of recombinants - Insertional inactivation (antibiotic resistance, blue white selection) colony hybridiration, immunological screening. Cloning strategies, genomic & cDNA cloning.

Unit V

Blotting techniques - Southern, Northern, Western. PCR - basic principle & applications. DNA sequencing - chemical & enzymatic methods. Site - directed mutagenesis – (brief account only). Hazards & safety aspects of genetic engineering.

Reference Books

IMBT 53 - Microbial Genetics and Molecular biology

Objective

Objective of the course is to give knowledge about molecular biology and genetics of microorganisms.

Unit I

Recombination, Transformation, Transduction - Generalized, Specialized, Conjugation, Hfr triparental mating.

Unit II


Unit III


Unit IV

Transcription, RNA Polymerase Promotor, Steps in transcription, Initiation, elongation & termination, Reverse transcription, post transcriptional processing.

Unit V

Genetic code, steps in translation - Amino acid activation, initiation, chain elongation & termination. Inhibitors of protein synthesis. Post transcriptional modification, Regulation of gene expression. Brief account of *lac* operon

Reference Books

IMBT 54 - Soil & Agricultural Microbiology

Objectives

The aim of the course is to learn about the role of microorganisms, their applications in soil and agriculture.

Unit - I


Unit - II

Microbial ecology - nature of soil organisms and their interactions - positive and negative interactions - mycorrhizal symbiosis - management of mycorrhizae - inoculum production and use - applied aspects of ecto and endo mycorrhizae. Rhizosphere and spenosphere.

Unit - III


Unit - IV


Unit - V

Microbial control of insect pests - control of soil borne microbial pathogens and nematodes - interaction of pesticides with soil microorganisms. Effects of microorganisms on pesticides. Effect of plant protection chemicals on soil microorganisms. Microbial herbicides.
Reference Books


IMBP 55 - Practical IV (Medical Microbiology, Genetic Engineering, Molecular biology & Microbial Genetics, Soil & Agricultural Microbiology)

1. Acid fast Staining.
2. Capsule Staining.
3. Identification of pathogenic microorganisms from a given sample and biochemical identification for the following bacteria up to species level
4. Isolation and characterization of bacteriophage from natural sources.
5. Cultivation of virus in chick embryo.
6. Genomic DNA isolation
7. Plasmid DNA isolation
8. Restriction digestion
9. Transformation
10. PCR
11. Western Blotting (Demo)
12. Isolation and enumeration of soil microorganisms (fungi, bacteria and actinomycetes).
13. Isolation of free – living nitrogen fixing bacteria from soil – *Azotobacter*.
15. Isolation of phosphate solubilizers, ammonifiers and denitrifers.
16. Study of Mycorrhizae, Cyanobacteria and *Azolla*. 
IMBT 61 - Industrial Microbiology

Objectives
To study about the industrially importance microorganisms, fermenter design, fermentation process.

Unit I
Industrially important microorganisms - Isolation, preservation and improvement of strains - handling - development of inoculum for various fermentation processes, upstream processing - media for industrial fermentation - formulation - sterilization.

Unit II
Fermentor design - Body construction, individual parts, heat production - gas liquid exchange - mass transfer - heat transfer - oxygen transfer - stirring and mixing - Newtonian, non-Newtonian fluids - effect of viscosity - scale up - control of temperature, pH, foam, pressure - Sterilization of Bioreactors and nutrients, computer application in fermentation technology.

Unit III
An Introduction to fermentation process - The range of fermentation process, chronological development - component parts of fermentation process - fermentation economics. Fermentation types - submerged and solid state fermentation.

Unit IV
Downstream processing - Recovery of intracellular and extra cellular products - Biomass separation by centrifugation, filtration, flocculation and other recent developments, Cell disintegration - physical, chemical and enzymatic methods. Extraction - solvent, two phase, liquid extraction, whole broth, aqueous multiphase extraction. Purification by different methods, Concentration by precipitation, ultra filtration, reverse osmosis. Drying and crystallization.

Unit V
Microbial production of organic acids - Amino acids, antibiotics - enzymes - vitamins - alcoholic beverages - wine and beer, Fermented foods - bread, cheese.

Reference Books
IMBT 62 – Immunology

Objectives

The aim of the course is to teach the basic concepts of immunology and immunological mechanisms.

Unit - I

Cells of the immune system, T cells, B cells, Macrophages, mast cells, granulocytes, NK cells. Phagocytosis, T cell and B cell receptors and function. Antibody dependent cell mediated cytotoxicity. Blood groups- Blood transfusion-Rh factors- Rh incompatibility

Unit - II


Unit - III

Types of immunity: Innate and acquired, active and passive - physiology of Immune response - Humoral immunity and cell mediated Immunity: Central and peripheral lymphoid organs - primary lymphoid organs - secondary lymphoid organs-Thymus, Bone marrow, spleen, lymph node- peripheral lymphoid tissue GALT

Unit - IV

The Complement system- classical and alternate pathway. Major histo compatibility complex- class I and class II MHC structure and function. Transplantation immunity - organ transplantation and HLA tissue typing -Immunological tolerance - immunosuppression. Autoimmune disorders and immunology of infectious disease. Hypersensitivity definition and types I to IV (Brief details only)

Unit - V
Antigen - Antibody reactions – Agglutination - Precipitation, Complement fixation - Immunofluorescence, ELISA, RIA. Hybridoma technology and Monoclonal antibodies - applications. Vaccines - DNA vaccines recombinant vaccines - Edible vaccines, multivalent subunit and anti - Idiotype vaccines. Recombinant vaccine

**Reference books**


**IMBT 63 - Environmental Microbial technology**

**Objectives**

To provide a fundamental knowledge about the various scopes in environmental studies.

**Unit - I**


**Unit - II**


**Unit - III**

Aerobiology-Droplet nuclei, aerosol, assessment of air quality, - solid - liquid-impingement methods - Brief account of air borne transmission of microbes - viruses - bacteria and fungi, their diseases and preventive measures.

**Unit IV**


**Unit V**

Bioremediation & Global environmental problems Microbiology of degradation of xenobiotics in the environment, ecological considerations, decay behavior, bio magnification and degradative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants and pesticides. Genetically Modified Organisms released and its environmental impact assessment and ethical issues-Ozone depletion, UV-B, greenhouse effect and acid rain, their impact and biotechnological approaches for management.
**Reference Books**


IMBT 64 - Food and Dairy Microbiology

Objectives

The emphasis of the course will be on characteristics and applications, food and dairy microflora and preservation, food quality and control measures.

Unit - I

Importance of food microbiology - types of microorganisms in food - source of contamination (Primary Sources) - factors influencing microbial growth of food (extrinsic and intrinsic) Regulations in food industry-The Food Safety and Standards Authority of India, INFOSAN.

Unit II

Food fermentations: Cheese, bread, wine, beer, fermented vegetables - methods and organisms used. Food and enzymes from microorganisms-single cell protein. Production of amylase, protease and other enzymes from food.

Unit III

Contamination, spoilage and preservation of cereals and cereals products, sugar and sugar products, Vegetables and fruits, meat and meat products - fish and the sea foods, egg and poultry - dairy and fermentative products (ice cream and other products)

Unit IV

Food borne diseases, intoxication and food poisoning - Staphylococcus, Clostridium, Escherichia coli and Salmonella infections, Hepatitis, Amoebiosis and Mycotoxins. Encounter of Aeromonas in food. EHEC and enteropathogens.

Unit V

Food preservation: Principles - methods of preservation - Physical and chemical methods, food sanitation. Good manufacturing process - hazard analysis, critical control points and personnel hygiene.

Reference Books


1. Wine production – Alcohol Estimation, Sugar Estimation.
2. Production and Quantification of
   a. Alcohol
   b. Citric acid
   c. Protease
   d. Amylase
   e. Lipase
3. Immobilization technique (Sodium alginate method)
4. Immuno electrophoresis
5. ELISA
6. Bacterial examination of water (qualitative and quantitative).
7. Enumeration of microorganism from air. Settle plate technique.
9. Estimation of BOD.
10. Estimation of COD.
11. Microbial Spoilage of Vegetables
12. Microbial spoilage of Fruits
13. Isolation of Mycotoxigenic fungi from cereals and oil seeds
14. Examination of Unspoiled canned foods for sterility and quality
15. Spoilage of Sea foods
16. Spoilage of Eggs
17. Effect of sodium chloride on the growth of food
18. Effect of sucrose on the growth of food microflora
19. Role of yeast in Bread making
IMBT 71 – Bioinformatics

Objectives
The aim of the course is to make the students to understand the application of computer technology in biological studies, use of internet and Bionet.

Unit - I
Introduction to bioinformatics, scope of bioinformatics, role of computers in biology. The internet, the world wide web, useful search engines – Boolean searching, search engine algorithms. Finding scientific articles – Pubmed. Running computer software, computer operating systems. Software downloading and installation.

Unit - II
The bioinformatics workstation, Unix system, files and directories in Unix, working on a Unix system. Scripting languages – Perl and Python, markup languages – HTML, XML.

Unit - III
Database concepts – Database, database system, database management systems – Hierarchical, Rational and Network, Database security. Biological databases, Types – sequence and structure databases. Genome and organism specific databases. Miscellaneous databases. Data submission, data retrieval with Entrez, DBGET / Link DB and SRS.

Unit - IV

Unit - V
Obtaining, viewing and analyzing structural data, structural alignment. Classification of protein structures. CATH and SCOP. Protein structure prediction- secondary structure prediction, Tertiary structure prediction- Homology modelling, protein threading, ab initio protein folding. CADD Molecular docking, Metabolic pathway reconstruction- Kegg

Reference Books
IMBT 72 - Microbial diversity and Extremophiles

Objectives
The aim of the course will be on the concept of microbial diversity and characteristics of microorganisms in extreme conditions.

Unit - I
Biodiversity Introduction to microbial biodiversity - distribution, abundance, ecological niche. Types - Bacterial, Archael and Eucaryol.

Unit - II

Unit - III
Alkalophiles and Acidophiles Classification, alkaline environment, soda lakes and deserts, calcium alkalophily Applications. Acidophiles Classification, life at low pH, acidotolerance, applications.

Unit - IV
Halophiles and Basophiles Classification, Dead Sea, discovery basin, cell walls and membranes - Purple membrane, compatible solutes. Osmoadaptation / halotolerance. Applications of halophiles and their extremozymes. Barophiles: Classification, high-pressure habitats, life under pressure, basophile, death under pressure.

Unit - V
Space Microbiology aims and objectives of Space research. Life detection methods - Evidence of metabolism (Gulliver) - Evidence of photosynthesis (autotrophic and heterotrophic) - ATP production - Phosphate uptake - Sulphur uptake. Martian environment (atmosphere, climate and other details).

Reference Books
1 Om V. Singh, Extremophiles: Sustainable Resources and Biotechnological Implications, 2012, Wiley-Blackwell
2 C Gerday, N Glansdorff, Physiology and Biochemistry of Extremophiles, 2007, ASM Press
3 R P Anitori, Extremophiles: Microbiology and Biotechnology , 2012, Caister Academic Press
IMBP 73 - practical VI (Bioinformatics, Microbial diversity & extremophiles)

1. Isolation of thermophiles from hot water spring [Study at least one enzyme].
2. Studies on halophiles isolated from seawater. [Pigmentation and Salt tolerance]
3. Studies on alkalophiles isolated from lonar water/sea water. [Study at least one enzyme]
4. Biogenic methane production using different wastes.
5. Isolation of *Thiobacillus ferrooxidans* and *Thiobacillus thiooxidans* cultures from metal sulfides, rock coal and acid mine waters.
6. Sequence alignment and searching.
7. Gene prediction.
8. Multiple sequence alignment.
10. Protein sequence analysis.
11. Protein structure prediction.
12. Protein structure alignment and comparison.
13. Primer design.
14. SNP finding in DNA sequence.
15. ORF finding in DNA sequence.
16. Visualization tools
IMBT 75 Elective - II Bioremediation

Unit - I
Principles of Bioremediation – Rapid growth and Metabolism- Genetic plasticity – Metabolic pathways for the degradation of xenobiotics, hydrocarbons – Microbial site characterization – Biodegradation potential

Unit - II
Bioprocess design, optimization – Microbial removal rates – inherent problems associated with biotreatment studies. Microbiological methodologies – Standard biotreatability protocols – Quantification of biodegradation; Biocleaning -Chernobyl radioactive contaminated area - Phytoremediation.

Unit - III

Unit - IV

Unit - V
Anoxic/Anaerobic Bioremediation: Anoxic/Anaerobic Processes – Fermentation, Degradation of xenobiotic – Anoxic/Anaerobic bioremediation of hydrocarbons, Phenols, Chlorophenolic compounds, Polycyclic Aromatic Hydrocarbons (PAH), Heterocyclic Compounds, Cyanide, dyes, Radioactive wastes.

Reference Books
IMBT 81 - Medical parasitology and Medical mycology

Objective
This paper is focused for the fungal and Parasitic disease associated with human beings for their etiology, diagnosis and treatment.

Unit - I

Unit - II

Unit - III
Introduction and classification of parasites, transmission lifecycle, lab diagnosis, preventive measures and treatment for the following Protozoa Entamoeba. Aerobic and Anaerobic Amoebae causing human disease. Toxoplasma, Cryptosporidium and other Protozoan parasites causing infection in man Leishmania, Trypanosoma, Giardia, Trichomonas, Balantidium.

Unit - IV
Classification, lifecycle, transmission, Pathogenicity, Lab diagnosis for the following Helminthes – Cestodes - Taenia Solium, T. Saginata, Echinococcus granulosus, Fasciola hepatica, Paragonimus - schistosomes- Ascaris lumbricoides, Ancylostoma duodenale, Trichinella, Enterobius and Wuchereria bancrofti.

Unit - V
Laboratory diagnosis of Parasitic infections - Examination of feces - Direct and concentration techniques, serological techniques.

Reference books
IMBT 82 - Medical diagnostic technology

Objectives
The emphasis of course is to learn the diagnostic methods and sample collection to diagnose the disease.

Unit - I
Organization of laboratory and safety precautions in laboratory and personal cleanliness and care with regards to infected materials and chemical burns. Quality assurance and disposal of wastes. Maintenance of clinical laboratory instruments. Regulatory agencies NABL

Unit - II
Sample collection, preservation and transportation of various clinical pathology samples. Pathological analysis of clinical specimens

Unit - III
Collection and analysis of Blood, Blood grouping systems, Rh typing, Blood bank operation

Unit - IV
Tissue reception, labeling, fixation for different tissue and section cutting. Preparation of paraffin blocks (Dehydration, clearing, embedding, blocking). Handling and care of microtome sharpening of razors, and section cutting. Preparation of common stains. H & E, congo red, methyl violet, Leishman stain, Giesma, VG, PAS, PASM etc. and staining techniques.

Unit - V
Serology- Serological methods for diagnostic purpose – Agglutination- Widal, VDRL, RPR, ASO, CRP test, latex agglutination test, Precipitation, CFT, ELISA, RIA, CLIA

Reference Books
1. Todd and Sanford, clinical diagnosis by laboratory method.2011, Nabu Press
2. G. Orchard, B Nation Histopathology (Fundamentals of Biomedical Science), 2011, OUP Oxford
4. Bain, Dacie and Lewis Practical Haematology.2011, Elsevier
5. Ramani Sood. Laboratory technology (Methods and interpretations) 6th Ed.2009 J.P. Bros, New Delhi
IMBP 83 - Practical VII (Medical parasitology & Medical mycology, Medical diagnostic technology)

1) Skin/nail scrapings for fungi isolation

2) Lacto phenol cotton blue mount for identification of fungi

3) Germ tube test for yeast

4) Sugar assimilation test for yeast

5) Cultivation of following fungi and their identification in SDA and corn meal Agar
   
   *Mucor, Rhizopus, Penicillium, Candida, Aspergillus*

6) Isolation of ova/cyst in Faeces (Direct and concentration methods).

7) Spotters of Anopheles, Glossina, Ticks, Mites *Aedes* etc.

8) Blood smear examination for Malarial parasites.

9) Different methods of blood collection & Preparation of anticoagulant bottles

10) Total & Differential WBC count

11) Antibiotic sensitivity test-MIC, MBC, Agar dilution, Broth dilution, Disc diffusion.

12) Cross matching –Major, Minor

13) Antistreptolysin’O test

14) CRP

15) Rheumatoid factor test

16) Fixing and staining of tissues for pathological examination
IMBE 84 Elective - III Quality control and IPR

Unit - I

Bioethics - Definition - Principles of Bio ethics - General issues related to environmental release of genetically modified microorganisms. Ethical issues related to the use of animal as models for microbial diseases- Animal ethics norms in India - Licensing of animal house - Ethical clearance norms for conducting studies on human subjects. Ethical issues related to research in embryonic stem cell cloning.

Unit - II

Biosafety - Introduction. Different levels of biosafety. Guidelines for recombinant DNA research activities in microorganisms. Good Laboratory Practices (GLP). Containments - Types. Basic Laboratory and Maximum Containment microbiology Laboratory research.

Unit - III

Introduction to Intellectual Property - IPR - Definition - Types of IPR: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, IP as a factor in R&D; IPs of relevance to Microbiology/ Biotechnology and few Case Studies WTO - Definition - Functions - Forms of IPR Protection.

Unit - IV

Agreements and Treaties-History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments

Unit - V

Basics of Patents and Concept of Prior Art IPR & edits. Introduction to Patents; Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and complete; process of patenting, Indian and international agencies involved in IPR & patenting, Global scenario of patents and India’s position, patenting of biological material, GLP, GMP.

Reference Books

8. Recombinant DNA safety guidelines (January1990), Department of Biotechnology, Ministry of Science & Technology, Government of India, New Delhi.
IMBE 85 Elective - IV Microbial metabolites

Unit - I

Unit - II

Unit - III

Unit - IV
Microbial vitamins Characteristics of fats and water soluble vitamins. Structure, function and chemistry of: Retinol (VitaminA), Riboflavin vitaminB2), Cyanocobalamine (VitaminB12) and ascorbic acid (vitaminC).

Unit - V
Biopolymers: Polypeptides (collagen, casein and serum albumin), Polynucleotides and polysaccharides (amylose, amylopectin, alginate, cellulose) and other biopolymers like chitin, Xanthan, dextrin, Gellan, Pullulan, curdlan and hyaluronic acid. Polyamines: Brief outline and functions of polyamines. Synthesis of linear polyamine-putrescine, cadoverine, spermidine and spermine.

Reference Books
2. MC Flickinger Encyclopedia of Bioprocess Technology: Fermentation, Biocatalysis and Bioseparation ,1999, Wiley and Sons, N. Y.
Objectives

The emphasis of the course is learning the energy sources, utilization of biomass for energy production and as biofuels.

Unit - I


Unit - II

Bio gas plants Biogas plant - Types – Construction details - Loading of biogas plants - Biogas requirement for various use - Biogas applications - dual fuel engine.

Unit - III

Alternative feedback for biogas plants. Effective use of Agricultural, Horticultural, Forest and fishery wastes and byproducts as an alternative feed stock for biogas plants – Bio digested slurry - Manure value - Enrichment - Pelletization.

Unit - IV

Utilization of biomass for energy production. Bio mass residues for agriculture, Horticulture, forest and fishery energetic – fast growing biomass species as energy source - solid, liquid, gaseous energy production from biomass and its use.

Unit - V

Biomass briquetting - coir pith groundnut shell etc., Alcohol from sweet sorghum, tapioca, sweet potato - producer gas - Aqua gas, pyrolytic gas from biomass such as maize cob, groundnut husk, cotton stalk, briquettes.

Reference Books

IMBT 92 - Enzymes

Objectives
The aim of the course is about the classifications, nomenclature and mechanism of the enzyme action.

Unit - I Enzyme classification and nomenclature of enzymes (IUB); extraction, isolation and purification of enzyme by various methods. Units of enzyme activity - International unit. Mechanism of enzyme action - concept of active site and energetic of enzyme substrate complex formation - specificity of enzyme action;

Unit - II Kinetics of single substrate reactions - turnover number - Michaelis - Menten’s equation $K_m$, $V_{max}$ two-substrate reactions – mechanisms. Kinetics of allosteric enzymes, Sigmoidal plot

Unit - III Enzyme inhibitions - Kinetics of competitive, non-competitive & uncompetitive inhibition; nucleophilic and electrophilic attack; role of metal ions in enzyme catalysis.

Unit - IV Immobilized enzymes - principles & techniques of immobilization - commercial production of enzymes; amylases, proteases, cellulose, artificial enzymes, fermentation, site directed mutagenesis; immobilized enzyme in industrial processes. Industrial uses of enzymes, food, detergents, energy, waste treatment, pharmaceuticals and medicine.


Reference Books
IMBP 93 - Practical VIII (Biofuel & Bioenergy, Enzyme technology)

1. Screening for amylase producing microbes from soil
2. Screening for lipase producing microbes from soil
3. Screening for protease producing microbes from soil
4. Isolation of extra cellular enzymes.
5. Isolation of intra cellular enzymes.
7. Purification of enzymes.
8. Assay of enzyme activity amylase
9. Assay for enzyme activity Protease
10. Enzyme kinetics $V_{\text{max}}$ Value
11. Enzyme kinetics $k_m$ value
12. Immobilization of enzyme
13. Quantification of biogas from different feedstock.
IMBE 94 Elective - V Genomics and Proteomics

Unit - I

Definition of Genomics - Mapping Genome – size-complexity- structure and function of prokaryotic and eukaryotic genome. Physical mapping of genome- Sequencing whole genome- Restriction mapping - FISH - STS mapping - Hybridization assays - Physical mapping without cloning- Mapping by genetic techniques - DNA markers - RFLPs, SSLPs, SNPs - Linkage analysis - Cross breeding and pedigree analysis.

Unit - II


Unit - III

Genome Analysis Overview of sequence analysis- Gene prediction - Tools for genome analysis. Detecting open-reading frames-using homology to find genes- software programs for finding genes- Identifying the function of a new gene - Analyses not based on homology- Genome annotation- Molecular phylogenetics. History of proteomics - from transcriptome to proteome.

Unit - IV

Tools of protein separation, analysis and characterization. Protein digestion techniques. Protein fingerprinting. 2D electrophoresis. Mass spectrometry - ESI and MALDI - TOF, SELDI - TOF (surface enhanced laser desorption time of flight), NMR, X - ray crystallography, phage display, yeast 2+ Hybrid system, surface plasma resonance Applications of proteomics - mining proteomes, protein expression profiling, identifying protein - protein interactions and protein complex, mapping protein modifications.

Unit - V
Metagenomics - Introduction, Methods, Sequence driven approach, Functional metagenomics, Applications, Advantages, Limitations, DGGE Genomics: The Science and Technology behind the human project.

**Reference Books**


2. Dale and Schantz, From Genes to Genomes, 2011, Wiley-Blackwell


IMBE 95 Elective VI Bioinstrumentation and Research methodology

Unit - I

Unit - II
Thesis writing - defining research problem, research design, general format, literature survey, primary source - articles, reviews, abstract, current contents (both text and CCOD), reference card, data analysis, data interpretation, report writing, proof correction.

Unit - III

Unit - IV

Unit - V

Reference Books


IMBT 101 – Biopharmaceuticals

Objectives
The aim of the course will be on the study of Pharmaceutical products.

Unit - I
Antimicrobial drugs, Chemical disinfectants, antiseptics and preservatives. Definition, Types of antimicrobial drugs, (Aminoglycosides, b lactams, Tetracyclines, Ansamycins, macrolid antibiotics) Antifungal antibiotics, antitumor substances. Peptide antibiotics, Chloramphenicol, Sulphonamides and Quinolinone )

Unit - II

Unit - III
Microbial contamination and spoilage of pharmaceutical products (Parenterals & non parenterals, ophthalmic preparations and implants) and their sterilization other pharmaceuticals produced by microbial fermentations (Streptokinase, Streptodornase). New vaccine technology, DNA vaccines, synthetic peptide vaccines, multivalent subunit vaccines. Vaccine clinical trials.

Unit - IV

Unit - V
Quality Assurance and Validation, Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry. Regulatory aspects of quality control. Quality assurance and quality management in pharmaceuticals ISO, WHO and US certification. Sterilization control and sterility testing (heat sterilization, D value, Z value, survival curve, Radiation, gaseous and filter sterilization) Chemical and biological indicators. Design and layout of sterile product manufacturing unit

Reference Books


4. J.Rehm & G.Reed , Biotechnology, 2012, Wiley India Pvt Ltd.

**IMBT 102 - Microbial inoculants and Mushroom technology**

**Objectives**

The aim of the course will be on the study of production and distribution of mushrooms and microbial inoculants.

**Unit - I**

Edible and non-edible mushroom (Historical account, most commonly cultivated mushrooms in the world, distribution and production in various countries).

**Unit - II**

Cultivation of button mushroom - morphology raising a pure culture & spawn preparation. Preparation of compost & cultivation of *Agaricus bisporus, Pleurotus flabellatus*, harvest.

**Unit - III**

Cultivation of oyster and paddy straw mushroom - preparation of pure culture & spawn cultivation methods, harvest.

**Unit - IV**


**Unit - V**

Fungal Biofertilizers - Ectomycorrhizal association with pines: Vescicular arbuscular mycorrizal association (VAM) - *Glomus* sp: Actinomycetes as Biofertilizers - Actinomycetes associations - *Frankia* sp.

**Reference Books**

IMBP 103 - Practical IX (Biopharmaceuticals, Microbial inoculants & mushroom technology)

1. Spectrophotometric / Microbiological methods for the determination of Griesofulvin.
2. Bioassay of chloramphenicol by plate assay method or turbidimetric assay method.
3. Treatment of bacterial cells with cetrimide, phenol and detection of Leaky substances such as potassium ions, aminoacids, purines, pyrimidines and pentoses due to cytoplasmic membrane damage.
4. To determine MIC, LD 50 of Beta-lactum/aminoglycoside/ tetracycline/ansamycins.
5. Sterility testing by Bacillus stearothermophilus
6. Sampling of pharmaceuticals for microbial contamination and load (syrups, suspensions, creams and ointments, ophthalmic preparations).
7. Determination of D value, Z value for heat sterilization in pharmaceuticals.
8. Determination of antimicrobial activity of a chemical compound (Phenol, resorcinol, thymol, formaldehyde) to that of phenol under Standardized experimental conditions.
9. Cultivation of button mushroom
10. Cultivation of Oyster mushroom
11. Production of microbial inoculants
12. Cultivation of Azolla
IMBT 104 Elective VII Entrepreneurship and Management for Microbiology

Unit - I

Unit - II
Institutions and schemes of government of India- Schemes and programmes. Department of science and technology schemes, Nationalized banks - other financial institutions, etc - SIDBI - NSIC - NABARD - IDBI - IFCI - ICICI etc.

Unit - III
Skills for entrepreneurs - communication skills, problem solving skills; Business plan development; Market need - market research, SWOT analysis, identify your competition. Financial plan - obtain financing for your business, insure your business, Marketing - mix product, distribution, price, promotion, set marketing goals.

Unit - IV
Composting - domestic waste, agricultural and industrial waste, vermi - composting. SCP production - mushroom cultivation.

Unit - V
Biofertilizers and Biopesticides. Production of teaching kits (plasmid DNA isolation, serum electrophoresis) and diagnostic kits (WIDAL test kits, ABO blood grouping kits)

Reference Books
1. P S. Teng, Bioscience Entrepreneurship in Asia: Creating Value with Biology, 2007, World Scientific Publishing Co Pte Ltd
functions and limitations of Statistics - Collection; data; Diagrammatic representation of data - Simple; frequency polygon; frequency curve and ogive; Primary and secondary data; Tally; Tabulation; Diagrams - Bar diagram; Pie diagram; and Graphical representation of data - Simple; tendency - Mean; Median and Mode and their practical application; Analysis of Binomial and Normal distributions; Measures of Skewness - Pearson's moment method; Measures of Kurtosis - Pearson's method; Measures of Dispersion - Range; Quartile Deviation; Mean Deviation; Standard deviation; Coefficient of variation; Correlation - Scatter diagram; Rank correlation; Regression and their equations; Standard methods of obtaining correlation coefficient; Sampling and the sampling distribution - Mean and Standard deviation; large sample test - means; paired sample test - means; test for correlation and regression; Goodness of fit - chi square test; Analysis of variance; one way and two way classification; Analysis of variance - linear; Analysis of variance - factorial; Analysis of variance - twoway; SPSS - Analysis of variance; Analysis of covariance; Multiple regression analysis; logistic regression analysis; Factor analysis; Discriminant function analysis.